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Pine Plantation Studies

Near Apple Creek, Wayne County, Ohio

Austrian Pine plot after pruning and thinning.

Ohio Agricultural Experiment Station
Wooster, Ohio

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OHIO AGRICULTURAL EXPERIMENT STATION
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PINE PLANTATION MANAGEMENT STUDIES NEAR APPLE CREEK, WAYNE COUNTY, OHIO

by

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Many of Ohio's planted forests on farm lands are badly in need of adequate care. More is required for a successful plantation, of course, than just to plant the trees and watch them grow. Agricultural crops improve with intensive management, and so do planted trees benefit from proper cultural operations. Owners who do a good job of weeding, pruning, and thinning can convert these neglected acres to busy acres bringing a satisfactory return on the investment. Forest research helps to point the way.

Research is needed on forest planting practices, particularly those inherited from early European experience but not necessarily applicable to 20th century American conditions. Opinions vary widely, for example, as to the proper spacing between trees in a pine plantation to yield best results. Too close spacing, we know, may take more planting stock and labor than profitable use of the site necessitates. Conversely, too wide spacing, unless early pruning is done, might result in wood products of undesired quality.

What follows is a report on silvicultural studies by research foresters of the Ohio Agricultural Experiment Station, meant to interest or perhaps to assist the forest tree planter and the plantation owner.

WHITE PINE VARIED SPACING EXPERIMENT

Eastern white pine (Pinus strobus L.) is one of the best species to plant in Ohio for timber. Under intensive management for profit it ought to yield the maximum of clear instead of knotty wood. Yet when growing in pure stands, of whatever density, white pine self-prunes extremely slowly and hence must be artificially pruned to yield high-grade wood products without knots. Moreover, aside from the knots, some foresters insist that the tree's taper or bole form, and height growth, too, are governed by stand density.

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Accordingly, in order to obtain positive information on these and other tree planting problems, a 9-acre white pine varied spacing experiment was set up during 1954-55 on the Badger Farm near Apple Creek, in East Union Township, Wayne County. The planting site, situated at about 1200 feet elevation, is on Wooster silt loam soil that formerly had been tilled. Original soils of this type, derived from glacial deposits, had potentially high productivity.

The local terrain is of a rolling nature and traversed by a brush-lined ravine. Its greater portion slopes westward, but some faces south and the rest southwest.

Prior to this planting the scattered native trees and shrubs present had been cut. Their stumps had then been treated with 2,4,5-T to prevent resprouting.

Pine Spacings: The former old field site, supporting today some 8,000 young white pines, is divided into three contiguous blocks of five strips each (Fig. 1). The reforested strips vary in width from 8 to 12 rows. Spacings between planted pines are 5 x 5, 6 x 6, 7 x 7, 8 x 8, and 9 x 9 feet, but are replicated three times and their arrangement within the blocks randomized as follows:

- - - - - West to East - - - - -

Block A:	6' x 6'	9' x 9'	7' x 7'	8' x 8'	5' x 5'
Block B:	8' x 8'	7' x 7'	5' x 5'	6' x 6'	9' x 9'
Block C:	7' x 7'	6' x 6'	8' x 8'	9' x 9'	5' x 5'

Major Objectives of the project are to determine what effect, if any, these various pine spacings may have on:

(a) Crown closure within the plantation.
(b) Character of the resulting ground cover.
(c) Rate and extent of self-pruning.
(d) Growth in height, diameter and volume.
(e) Damage by wind, snow or ice glaze.
(f) Invasion by volunteer (native) vegetation.

The eventual outcome of the study, it is hoped, will provide a sound basis for recommendations to Ohioans seeking advice on reforestation.

Weedings: To date, this Badger Farm white pine plantation has been given three separate weedings or release cuttings, done during the late summer or autumn of '57, '58, and '60. Invading hardwood sprouts, briers, tall grasses and herbs have been cut back (lopped) and/or treated with "brush killer" (2,4,D + 2,4,5-T). Those encroaching volunteer plants which were overtopping or likely to overtop the planted pines were cut. Their control has done much to accelerate height growth of the plantation. Overall pine survival has been excellent, averaging now almost 94 percent (Table 1). Perhaps following another such treatment the pine canopy will close and competing vegetation be virtually eliminated.

Sample Plots: Fourteen 1/10-acre permanent sample plots, each having an isolation strip surrounding it, were established within the variously spaced plantings during September of 1960 (Fig. 1). Eventually all plot trees will be paint-numbered and taper and volume measurements made periodically.

Plots having 12 x 12 and 15 x 15 feet spacings between pines have also been set up, simply by removing enough trees to get the density desired. Actually, why plant 1,200 or more pines per acre if less than 200 of them can mature and early thinnings are unsalable?

Height data taken in 1960 showed no correlation whatever with tree spacing (Table 1). Explanation might rest on the fact that the tree crowns had not yet closed. Or subsequent data may disprove any possible relationship between tree height and stand density. Solution depends on the outcome of the experiment.

The white pines averaged 5.0 feet tall following an elapse of six consecutive growing seasons. Height dispersion in the plots ranged from 0.8 to 10.4 feet. Approximately 2 percent of the survivors had yet to struggle through the dense low grass, weeds and brambles.

Artificial Pruning: When should it be undertaken? Opinions differ. but we believe "as early as possible", while the pine stems and limbs are yet quite small. Prompt action assures an owner the maximum growth of clear wood and with the least expenditure of labor. The payoff comes when his sawlogs, if suitable for high-grade lumber, plywood or veneer, have a sale value 2 to 3 times that of the lower, knotty grades from an unpruned plantation.

Early pruning requires, of course, removal of many of the live limbs. But research finds it to be practical, providing not more than half of the green crown is eliminated. Pruning somewhat in excess of that amount may cause a small but temporary reduction of growth, which is more than compensated for by the value of the clear wood produced.

Within the period August 10 - September 15, 1960, every thrifty white pine on the 9-acre tract was trimmed from the ground upwards to about the mid-point on its trunk. In fact, only its main leader and two topmost whorls of limbs had been left.

Once they become 5 feet taller, each is to be trimmed to the 7-foot level, or to the height a man normally will reach with a 14-inch curved, orchard-type pruning saw. On the sample plots themselves, that amount of clearance suffices for ease of ingress and study activity, yet is not detrimental to the basic objectives of the experiment. Outside the plots, however, potential crop trees (200 - 300 per acre of the best pines) will eventually be chosen and high-pruned with pole-saws to 17 feet or one log length above ground. White pines of exceptional promise could be profitably pruned even higher, up to two-log lengths or 34 feet.

AUSTRIAN PINE PLANTATION MANAGEMENT

Adjacent to the white pine varied spacing experiment, but on the opposite (south) side of Wayne County Highway 163, there is a fine plantation of Austrian pine (Pinus nigra Arnold) belonging to the Apple Creek Hospital. It was established in 1938 at 6 x 6 feet spacing.

Row-thinning: This plantation had not received any intensive management prior to October 1953 when, after 16 growing seasons, its overstory pines were 5.6 inches in diameter breast high (4½ feet above ground) and 25 feet in height. Then it had been row-thinned, by clear-cutting every third row of the pines. The task was a cooperative undertaking between supervisory field personnel of the State Hospital and the Forestry Department of the Experiment Station.

Row-thinning represents a controversial issue to the forest researcher. Briefly, although it facilitates the marking, felling and skidding, and provides access lanes in plantations, from a silvicultural standpoint it sacrifices too many potential crop trees. Its advantage is that of expediency, and is practically limited to plantations left go too long without treatment. A much better procedure is to begin early in the life of the stand, at planting time even, and give the young pines "room to grow but with none to waste". Wide initial spacing allows for their proper development, without undue competition, until they attain a merchantable size making selection thinning profitable.

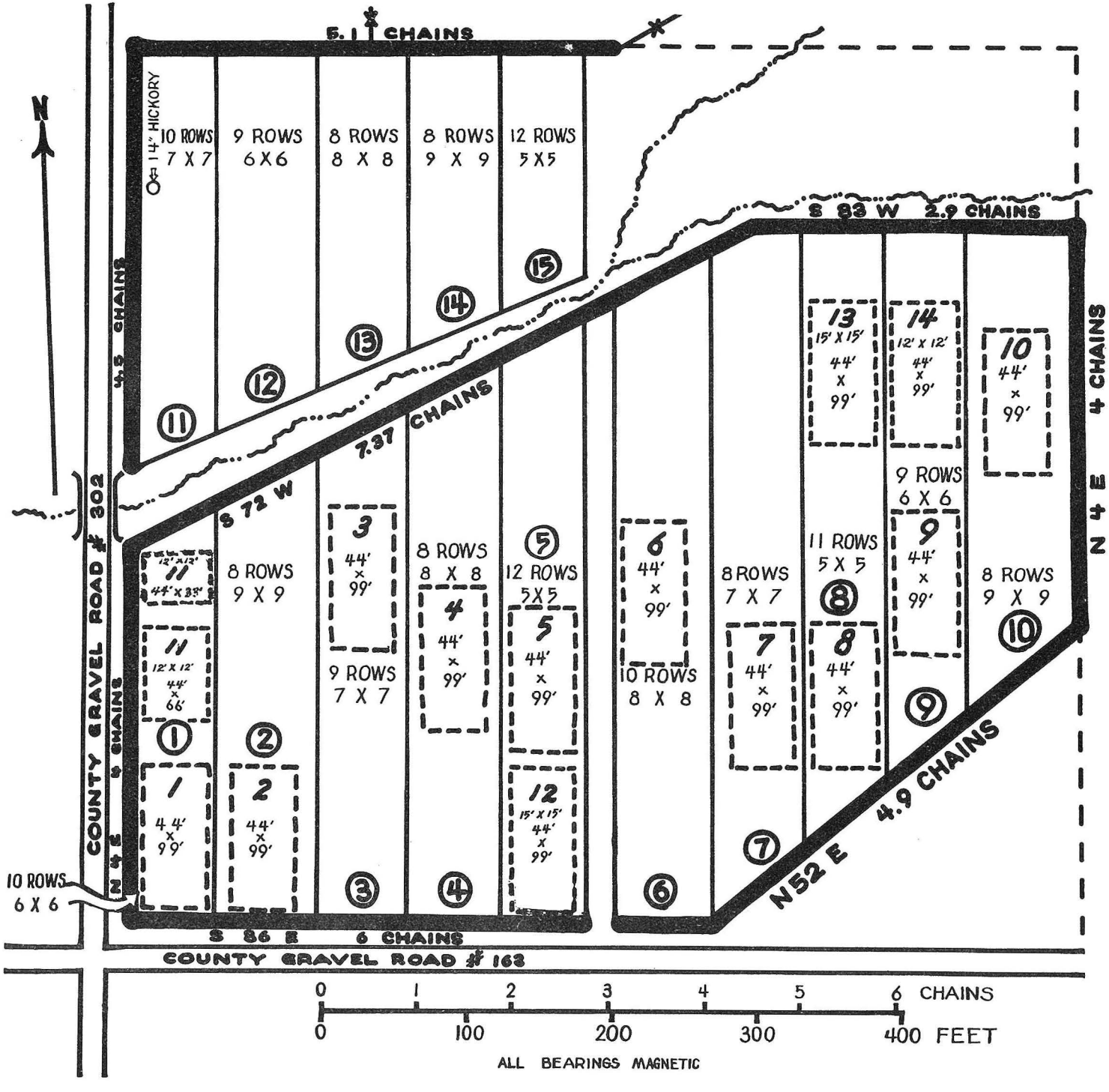
Low- and High-Pruning: Plantation pruning logically precedes thinning, for the function of the latter is to assist the specially treated crop trees. But not even low-pruning had been done until the fall of 1960. Then considerable time and effort was spent at developing there a model plantation management research and demonstration unit. An appropriate roadside sign will call it to public attention.

Every live Austrian pine in the 3-acre experimental block was first low-pruned to approximately a 7-foot height level. The next step was to select 200 per acre choice, well-spaced pines, band them with white paint and high-prune them with sectional aluminum pole-saws. Invariably the co-dominant pines having relatively small limbs and slight taper were best suited for preferential treatment as final-harvest trees. Marginal pines were left unpruned, in order to shield the treated plantation from the detrimental effects of sun and wind.

Pruning is a slow, arduous task, but if well done it leads to high-grade, knot-free wood products bringing premium prices. An average of 75 to 100 linear feet of stem were pruned per man-hour, the time factor varying with size and number of limbs per tree.

Selection Thinning: Finally, a considerable number of Austrian pines had been selected and marked for removal, the object being to aid each individual high-pruned crop tree and afford it adequate room for rapid growth. The operation was, to quote forestry terminology, a "crown thinning from above". A per acre average of 6.0 cords of wood had been

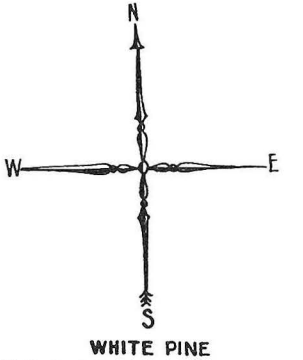
Figure 1



BADGER FARM WHITE PINE VARIED SPACING PLANTATION

JOHN E. AUGHANBAUGH

LEGEND
①②③④ ETC.= STRIP NUMBER
1,2,3,4 ETC.= PLOT NUMBER



WHITE PINE
VARIABLE SPACING EXPERIMENT
1954

FOREST PLANTATION MANAGEMENT
STATE PROJECT # 258

BADGER FARM
EAST UNION TOWNSHIP, WAYNE COUNTY

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

3 BLOCKS OF 5 RANDOMIZED STRIPS EACH

Figure 2.--Early pruning in white pine varied spacing plots was started in the fall of 1960. Trees were planted in spring of 1954 and 1955.

cut, as compared to 4.2 cords in 1953, and the management plan calls for other thinnings to follow at 5- to 10-year intervals.

Table 2 depicts the status of this excellent plantation preceding each of its two thinnings to date. Future stand treatments and re-measurements will provide additional information.

Table 1

COMPARATIVE SUMMARY OF SAMPLE PLOTS
IN THE WHITE PINE VARIED SPACING PLANTATION

Plot No.*	Spacing (Feet)	No. of Trees @ Plot	No. of Trees @ Acre	Survival (%)	Av. Height (Feet)
1	6 x 6	96	960	86	4.2
2	9 x 9	51	510	93	4.7
3	7 x 7	83	830	99	5.5
4	8 x 8	65	650	90	5.9
5	5 x 5	166	1660	92	5.1
6	8 x 8	72	720	100	5.3
7	7 x 7	77	770	92	4.9
8	5 x 5	167	1670	93	4.8
9	6 x 6	105	1050	88	4.7
10	9 x 9	52	520	95	4.3
11	12 x 12	35	350	100	4.2
12	15 x 15	24	240	100	6.2
13	15 x 15	20	200	100	5.7
14	12 x 12	28	280	93	5.1

*See Figure 1. Each plot 1/10-acre in size.

Table 2

GROWTH SUMMARY BEFORE THINNINGS[1]/
IN APPLE CREEK AUSTRIAN PINE PLANTATION[2]/

(Data on per acre basis)

Inventory Year	Age (Yrs.)	Trees (No.)	Basal Area (Sq. Ft.)	Diameter[3]/ (Inches)	Height (Feet)	Volume[4]/ (Cu.Ft.)
1953	16	1,220	122.1	4.3	22.0	1,611
1960	23	612	113.2	5.6	35.3	2,047

1/ 4.2 cords per acre removed in 1953, 6.0 cords in 1960.

2/ Based on a $\frac{1}{4}$-acre permanent sample plot.

3/ Average diameter breast high ($4\frac{1}{2}$ feet above ground) of all trees in the plot.

4/ Total cubic feet outside bark.

NOTE: Despite a 50% loss of trees in the 1953 thinning, growth in basal area and volume during the succeeding 7 years was remarkable.